CASE STUDY ON C-PROGRAMMING QUESTIONS FROM THE PERSPECTIVE OF BLOOMS COGNITIVE LEVEL

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ABSTRACT

Current education system is changing dynamically to bring out various skills of students/ learners. To make sure the learner learn what they ought to, Outcome based education is being adopted in higher education institutions. Educationalists suggest that assessment must be in such a way to evaluate different cognitive level of the students as proposed by Bloom. But still some gap prevails on how to set questions to check different cognitive levels of the students. This paper is intended to study how the question papers are set, taking "Computer Programming Course" as example and suggest few modifications that may be brought into the question papers to assess higher order thinking level of students. Study is made on the questions collected from question papers of different educational institutions and technical examinations. Analysis were made on how the questions are distributed based on the Blooms Taxonomy and the keywords used for constructing the questions. Findings reveal that the questions are not distributed well on the Blooms Taxonomy. Most of the questions fall in the lower order thinking categories. Higher order thinking levels are very much ignored especially in descriptive type questions. Based on the findings few improvements in the question setting were suggested.

KEYWORDS: Outcome Based Education, Blooms Taxonomy, Question setting, Programming language, C-Programming

I. INTRODUCTION

Outcome based teaching and learning is a pedagogical approach that gives importance to the learning outcomes. The learning outcomes are fixed based on the experience of the teacher or expert in that field. Curriculum/Syllabus is designed in such a way to achieve the required learning outcome [1]. Outcome Based Education (OBE), offers a powerful and appealing way of reforming and managing engineering education. In the tradition method teaching process was considered most important, whereas in Outcome Based Education the product that is produced is given importance. It gives importance to the quality of graduates produced; the graduates need to demonstrate the required knowledge, skill and attitude. Industry needs graduate who are qualified to work from day one.

Based on the direction given by NBA and other experts, in the recent past, the buzz word in all Engineering Institutions and Universities in India is "Outcome Based Education and Accreditation" [2]. To ensure the students are gaining proper knowledge, skill and attitude, NBA insist/ guide the institutions to practice the three learning domain the teaching learning process viz., cognitive, psychomotor and affective [3].

This paper intend to analyze the question setting patterns, whether it is based on the recommendation of Blooms taxonomy and the quality of keywords used in the questions. The paper is organized as follows, section II introduces Blooms taxonomy and explains the suggestive questions under various revised Blooms taxonomy. Section III describes the analysis done on the question collection and various patterns observed in question settings. Section IV summarizes the findings and suggests improvements in the questions settings.

II. BLOOMS TAXONOMY

Cognitive domain of Bloom's Taxonomy[4] is one of the three domains that were introduced by Benjamin Bloom in 1950s. This domain is designed to verify a student's cognitive quality during written examination. The famous Bloom's taxonomy consists of six levels i.e. knowledge, comprehension, application, analysis, synthesis and evaluation [4]. Later Anderson and Krathwohl [5] revised Bloom's taxonomy to fit the more outcome-focused modern education objectives. Revised Bloom's taxonomy includes remembering, understanding, applying, analyzing, evaluating, and creating.

The following [6] describe each levels of revised Bloom's Taxonomy:

Remembering
Students are expected to exhibit memory of previously learned material by recalling facts, terms, basic concepts, and answers. This level serves as the lower level or the beginning level of the hierarchy. Questions of this category include the facts/syntax they study in the programming language lessons.

Examples:
i. List few keywords of C.
ii. Define the syntax of "for"

Understanding
Students are expected to understand the concept and able to reproduce in their own way. The questions for programming in this category could be translating algorithm (e.g.; write output of a program), explaining the processes and flows of program and providing examples to illustrate a concept or an algorithm.

Examples:
i. What is the output of the following code segment?

ii. Explain the use of "function" with example.

Applying
Students are expected to understand the concept and able to apply it in a program given. Questions may be given to use the data type, data structure and control statements appropriately.

Examples:
i. Create an array for storing 100 numbers.

ii. Write a program to display highest number in the given set of values.

Analyzing
Students are able to examine and break information into parts by identifying motives or causes. Make inferences and find evidence to support generalizations. Students will be able to understand the working of individual component, relationships between the statements, how the codes work together and bring the output expected.

Examples:
i. How the array can be replaced using structures in the given program?

ii. Trace the control flow of program given, assuming random input to the variables.

Evaluating
Students are able to arrive at some conclusion from the given facts, present and defend their opinions by making judgments about information, validity of ideas, or quality of work based on a set of criteria.

Example:
i. Given <<a problem>> justify the data structure to be used

ii. Evaluate the correctness of a program (for the given problem whether the program written addresses it well).

Creating
Students are able to integrate the concepts by rearranging components into a new whole (a product, plan, pattern or proposal).

Examples:
i. Write a program that gets input, marks of 60 students from the user, finds sum and mean, and display the values to the user.

Challenge in classifying questions according to blooms taxonomy is the usage of same keywords in different blooms levels [7].

III. QUESTION ANALYSIS

With so much of work already published, is there any change in the mindset of question paper setter? This paper intended to verify the following:

1. Which cognitive level the questions are targeting?

2. Whether all the cognitive levels are covered?

3. What are the keywords used for different levels? whether it matches with the question keyword suggested in blooms taxonomy?

To answer the first question, analysis is done with hundred and three questions collected from question banks of various universities and technical exam. Questions collection include both descriptive and objective type. The questions collected are related to "C- Programming". All the questions were categorized manually. Here the questions categorized under "applying" are the questions ask the students/learners to write programs for doing simple and direct tasks, the questions categorized under "create" are the questions ask the students/learners to write programs for bit complicated tasks. Table 1 shows some of the sample questions collected. We can observe from the sample questions the quality of objective questions is better than the quality of descriptive questions, even though the cognitive levels tested are same.

Table 1. Sample question from the course "C-Programming"

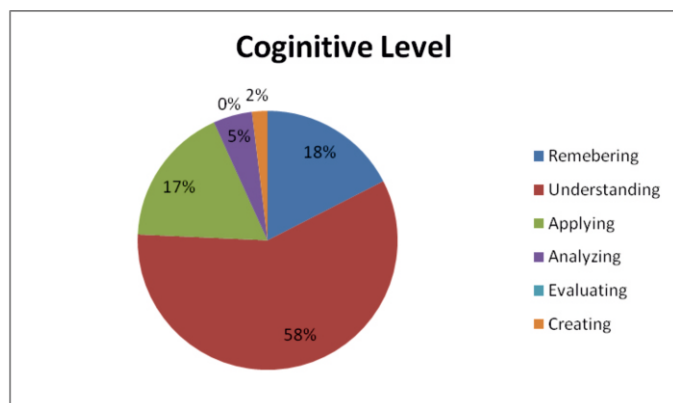| S. No.	Questions	Cognitive level
1	Define C Storages Classes?	Remembering
2	What is C operators? discuss about types of Operators?	Understanding
3	What is Arrays? also define types of arrays?	Understanding
4	What are Pointers? How to use Pointers?	Understanding
5	Write a Programs to Calculate sum of 5 Subject and find Percentage?	Applying
6	Explicit type conversion is known as A] conversion B] disjunction C] separation D] casting	Understanding
7	Study the following C program void main ( ) { int a= 0; for (; a ;); a++; } What will be the value of the variable a, on the execution of the above program A] I B] 0 C] –1 D] None of these	Analyzing
8	The meaning of arrow operator in a->b A] (*a).b B] a.(*b) C] a.b D] None of these	Understanding
9	What will be the value of x after executing the program? void main ( ) { int x; x = printf("I See, Sea in C"); printf("\n x= % d" , x); } A] x= 15 B] x=2 C] Garbage value D] Error	Analyzing
10	Which pair of functions below are used for single character I/O ? A] getchar() and putchar() B] scanf() and printf() C] input() and output() D] None of these	Remembering

Chart 1. Cognitive level distribution in question collection including both descriptive and objective

Chart 1 shows how the questions are distributed among various bloom's cognitive level. We could see 58% of the questions fall in the category of "understand-

ing", which falls under the "Lower Order Thinking" category. Even though the aim of higher education institutes is to improve higher order thinking, question are not very much motivating the students towards higher order thinking. Questions asked toward testing the creativity is of only 2%.

To answer the second question whether the question are distributed in all the levels, we can observe that the questions from higher order thinking, covering analyzing, evaluating, creating is very low and especially the evaluation is not at all covered in the questions collection we have taken. To have a closer look two other charts Chart 1 and 2 are furnished.

Chart 2, which describes the distribution of descriptive type question, clearly indicates that questions are not asked to verify the "analysis" and "evaluate" level in the written examination. In the written examination which is generally a long hour duration may include the question to check the "analysis" and "evaluate" level questions which is very much lagging in the question collection considered.
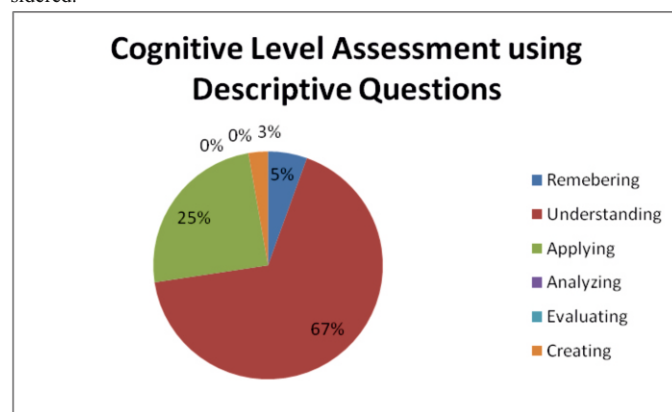

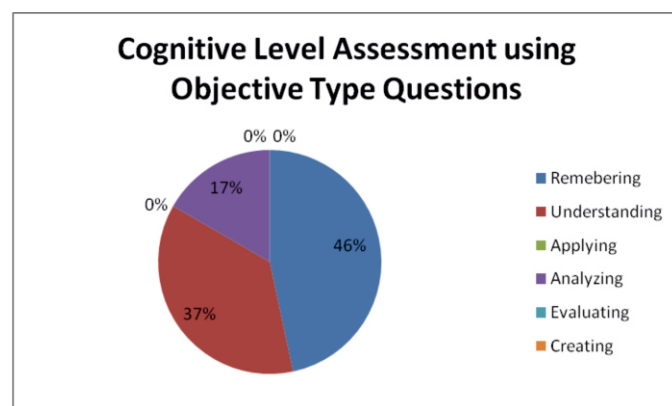**Chart 2. Descriptive Questions distribution in various Cognitive levels**

Chart 3. Objective Type Questions distribution in various Cognitive levels

Chart 3, which describes the distribution of objective type question clearly indicates that questions are not asked in the "apply" and "create" level in the examination since there is no provision for writing program in these technical (multiple choice questions) exams. Otherwise question distribution of objective type question among cognitive level is much better compared to the distribution of descriptive type questions.
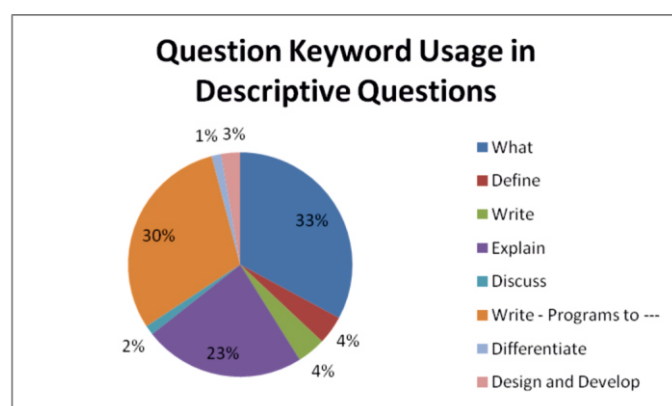

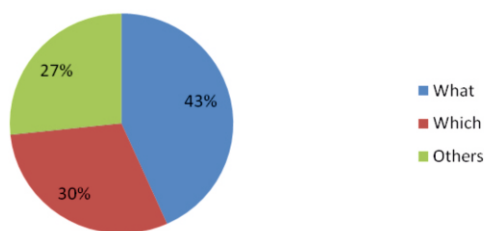**Chart 4. Question keywords used in descriptive questions**

Chart 5. Question keywords used in objective type questions

The chart 4 and 5 shows the question keywords used in descriptive type and objective type questions. In both the types, "what" is most commonly used.

"Which" type questions are present only in objective type questions. Since "Discuss", "Explain" are not used in objective type question as the scope do not permit it. In the descriptive type questions most of the questions fall under "understand" category and it uses the keyword "What", "Explain" and "Discuss". Almost all the questions are asked in the pattern of "Write a programme to do specific task" for apply category. The question asked in descriptive type is very monotonous. In the following section, paper suggest the possible changes that can be brought in to bring more higher order thinking questions, especially in the descriptive type questions

IV. DISCUSSION AND SUGGESTION

Analysis of question collection shows that 58% of the questions are asked to check the understanding of the students and the questions for checking the evaluation skill is nil. We could see very well that the coverage of all cognitive level is missing. Questions for higher order thinking is also very less in the question papers. Usage of keyword is also very similar.

Teachers need to kindle the thinking capacity of the students. To do that the examination question paper must have questions of different types using different type of keywords. This section suggests few modifications that can be used in the questions based on the verbs of blooms digital taxonomy [8].

Domain	Example Questions
Remembering	Name the keyword used for reading one single character.
	Match the following – • scanf()-print the character, string, float, integer, octal and hexadecimal values • printf ()-read character, string, numeric data from keyboard • putc()-print the character, string, float, integer, octal and hexadecimal values
	Which operator has the lowest priority ? A] ++ B] % C] + D] ||

Understanding	How many times "*" will be printed?
	int x = 0;
	do{
	  printf ("*");
	 x++;
	}while (x<10)

	Group the keywords used for file operations
Applying	Demonstrate the use of "for loop"
	Construct switch – case statements for finding the grade for given mark.
Analyzing	Differentiate the use of arrays and pointers

	What is the output of this program ?
	void main() {
	int a=b=c=10;
	a=b=c=50;
	printf("\n %d %d %d",a,b,c); }
	
	A] 50 50 50 B] Compile Time Error
	C]10 10 10 D] Three Gaebage Value

	In the following code make necessary changes to print the statement 5 times
	
	#include <stdio.h>
	int main () {
	  for(; ;) {
	    printf("This is in loop.\n");
	  }
	  return 0;}

Evaluating	Which data type/structure can be used to store information of 100 students?Justify.

	For the given problem find whether the code will produce the maximum number?
	
	/* function returning the maximum between two numbers */
	int max(int num1, int num2) {
	
	  /* local variable declaration */
	  int result;
	
	  if (num1 > num2)
	    result = num1;
	  else
	    result = num2;
	  return result;
	}

Creating	Draw a flowchart for calculating Electrical bill.
	Develop a C program for real time Bank application. The program is to perform all below operations. 1. Creating new account – To create a new account 2. Cash Deposit – To Deposit some amount in newly created account 3. Cash withdrawal – To Withdraw some amount from your account 4. Display Account information – It will display all informations of the existing accounts 5. Log out 6. Clearing the output screen and display available options

Few example questions given in this section will certainly improve the quality of question setting in programming language courses.

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